ZOOLOGY.—*The interrelationships of the subfamilies and genera included in the crinoid family Antedonidae.*[1] AUSTIN H. CLARK, National Museum.

Recently in the pages of this Journal[2] I proposed a rearrangement of the species of Antedonidae, distributing them among forty genera, which in turn were grouped in seven subfamilies.

In the following keys the interrelationships of the subfamilies, and of the genera within each, are shown.

Family ANTEDONIDAE Norman (emended)

Key to the Subfamilies of the Family Antedonidae

Cirrus sockets arranged in definite columns on a conical or columnar, usually large, centrodorsal.....ZENOMETRINAE

Cirrus sockets arranged in transverse alternating rows, or irregularly, on a hemispherical to discoidal or conical centrodorsal.

The segments of the genital pinnules are much expanded, forming a roof over the gonads.....ISOMETRINAE

The segments of the genital pinnules are not expanded.

P_1 is composed of numerous (usually more than 50 and never less than 30) short segments of which at least the first six or seven, and usually nearly all, are broader than long, and the distal are rarely more than twice as long as broad; P_1 is about as long as, or longer than, P_2.

One or more of the following pinnules resembles P_1. HELIOMETRINAE

P_2 and the following pinnules are composed of segments which, beyond the third or fourth, are much elongated.....THYSANOMETRINAE

P_1 is composed for the most part of much elongated segments, though a few of the basal segments may be short; the distal segments are at least twice as long as broad.

The distal cirrus segments are entirely without dorsal processes on their distal ends; the cirri are usually (but not always) short, rarely with more than 20, never with more than 30, segments..ANTEDONINAE

The distal cirrus segments always have the distal dorsal edge prominent, with the median portion more or less produced in the form of a dorsal spine, and the mid-dorsal line more or less strongly carinate.

[1] Published with the permission of the Secretary of the Smithsonian Institution.

[2] Journ. Wash. Acad. Sci., 7: 127–131. 1917.

P_2 resembles P_1, and always differs from the genital pinnules; P_a is frequently, and P_1 occasionally, absent.....PEROMETRINAE

P_2 resembles P_3 and the succeeding pinnules, and often bears a more or less developed gonad; all of the lower pinnules are invariably present.....BATHYMETRINAE

Subfamily ANTEDONINAE A. H. Clark

Key to the Genera of the Subfamily Antedoninae

P_2 of the same length and character as P_3 and the following pinnules, and much shorter than (usually about half as long as) P_1.

Pinnule segments with unmodified, or at the most with very finely spinous, distal edges; size medium, the arms rarely under 45 mm. in length (*Norway to the Gulf of Guinea, including the entire Mediterranean basin and the east Atlantic Islands; Caribbean Sea to Rio de Janeiro, Brazil;* 0–445 *meters*).....**Antedon**

Pinnule segments with strongly produced, everted and coarsely spinous distal edges; size small, the arms never over 70 mm. and rarely over 45 mm. in length (*Southern coasts of Australia northward throughout the East Indian region to southern Japan;* 0–275 *meters*).....**Compsometra**

P_2 not of the same length and character as P_3 and the following pinnules, and never only half as long as P_1.

P_3 of the same length and character as the succeeding pinnules.

Centrodorsal flattened hemispherical or discoidal; size medium, the arms being between 60 mm. and 120 mm. in length; P_1 has 18–40 segments.

P_1 longer than the cirri, becoming very slender and flagellate distally, composed of about 40 segments (*Ceylon to the Society Islands;* 0–47 *meters*)
Mastigometra

P_1 shorter than the cirri, less slender and more or less stiffened, composed of 18–21 segments (*Moluccas to China, and eastward to the Society Islands;* 0–397 *meters*).....**Euantedon**

Centrodorsal conical; size small, the arms being about 30 mm. in length; P_1 and P_2 have 12–13 segments (*Hawaiian Islands and northern New Zealand;* 108–293 *meters*).....**Argyrometra**

P_3 not of the same length and character as the following pinnules.

P_3 much the longest and stoutest pinnule on the arm.

The distal ends of the cirrus segments do not overlap the bases of those succeeding; the dorsal edge of the outer four to six cirrus segments is about as long as the proximal border; the brachials have

strongly produced and coarsely spinous distal edges (*Flores to Borneo and the Philippine Islands;* 0–502 *meters*) ..... **Toxometra**

The cirrus segments have produced distal ends which overlap the proximal ends of those succeeding; the outer cirrus segments are much longer than their proximal width; the brachials have smooth, or only very finely spinous, distal edges.

Smaller, with not over 16 cirrus segments; cirri less numerous, XX–XLV (rarely over XL); arms 23 mm. to 50 mm. long (*From the Red Sea to Madagascar and Mauritius, eastward to northern Australia and the East Indies, and northward to southern Japan;* 0–106 *meters*) **Dorometra**

Larger, with 16–33 cirrus segments; cirri more numerous, XXXV–LX (rarely less than XL); arms 75 mm. to 80 mm. long (*Lesser Sunda Islands to the Philippines;* 69–140 *meters*) **Eumetra**

P_3 not much the longest and stoutest pinnule on the arm.

P_1, P_2, and P_3 similar and of approximately equal length, with at least 13 segments.

P_1, P_2, and P_3 longer than the genital pinnules; the pinnules are not especially stiffened, and their component segments do not bear prominent spines on the distal edges; the centrodorsal is low hemispherical (*Philippine Islands to southern Japan;* 23–192 [?250] *meters*) **Iridometra**

P_1, P_2, and P_3 shorter than the genital pinnules; all the pinnules slender and stiff, especially the lower which are thorn-like with long spines on the distal edges of the segments; the centrodorsal is large, rounded conical (*Coast of Brazil;* 41 *meters*)..... **Hybometra**

P_2 much longer than P_1, and longer than P_3, though similar to the latter; centrodorsal more or less sharply conical (*Andaman Islands to southern Japan;* 54–201 [?250] *meters*) ..... **Andrometra**

Subfamily THYSANOMETRINAE A. H. Clark

Key to the Genera of the Subfamily Thysanometrinae

P_2 with the third segment as long as, or longer than, broad, and the following segments markedly longer than broad (*Southern Japan and the Admiralty Islands;* 126–355 *meters*) .... **Thysanometra**

P_2 with the third segment broader than long, and the fourth broader than long, or about as long as broad (*Caribbean Sea, and northward to North Carolina;* 13–1029 *meters*) ..... **Coccometra**

Subfamily PEROMETRINAE A. H. Clark

Key to the Genera of the Subfamily Perometrinae

P_1 and P_a absent; size small, the 10 arms being from 25 mm. to 35 mm. (usually between 25 mm. and 30 mm.) in length; cirri XX–XXX, 22–25, 10 mm. long (*West Indies;* 59–433 *meters*) **Hypalometra**

P_1 always present, though P_a (on the inner distal end of the first syzygial pair) is sometimes absent.

Ossicles of the IBr series and first two brachials with smooth and unmodified depressed borders, laterally in close apposition with their neighbors and sharply flattened against them; synarthrial tubercles (on the articulations between the elements of the IBr series and first two brachials) very prominent, sometimes extravagantly developed; P_1 is as long as, longer than, or shorter than, P_2; P_a may be absent; 10–14 (usually 10) arms from 35 mm. to 90 mm. long 28–55 cirrus segments (*From Madagascar to the Kei Islands and southern Japan;* 70–252 [?273] *meters*) ..... **Perometra**

The ossicles of the IBr series and first two brachials may be just in contact laterally, but their sides are never sharply flattened, and prominent synarthrial tubercles are never developed; their lateral borders always bear tubercles, one or many to each ossicle, and their distal and proximal borders are usually prominently everted and tubercular.

Interbrachial portions of the perisome naked; P_a always present (*Kei Islands and southern Japan;* 204–344 *meters*) **Nanometra**

Interbrachial portions of the perisome with numerous prominent rounded calcareous nodules which are not in lateral contact; P_a usually absent (*Moluccas and southern Japan;* 99–270 *meters*) ..... **Erythrometra**

Subfamily HELIOMETRINAE A. H. Clark

Key to the Genera of the Subfamily Heliometrinae

10 radials and 20 arms (*coasts of the Antarctic continent, and Kerguelen Island;* 18–400 *meters*) ..... **Promachocrinus**

5 radials and 10 arms.

Each brachial bears a high median carinate process; P_1 much longer than P_2 (*Coasts of the Antarctic Continent;* 223–400 [?900] *meters*) ..... **Anthometra**

No carinate processes on the brachials.

Brachials very short, much broader than long; middle and

distal pinnules with very short segments which are rarely longer than broad; cirrus segments very short, only very few, or none at all, longer than broad; P_1 and P_2 of approximately the same length (*Vicinity of Heard Island, and the winter quarters of the "Discovery;"* 135–270 *meters*) ..... **Solanometra**

Brachials longer, about as long as broad or slightly longer than broad; segments of the middle and distal pinnules longer than broad, usually very much so; a number of the earlier cirrus segments longer than broad.

P_1 with 30–45 segments of which those beyond the seventh to eleventh are longer than broad, the distal elongate, though never much more than twice as long as broad; P_2 is similar to P_1, but shorter (*Arabian Sea to southwestern Japan;* 192–2160 *meters*) ..... **Cyclometra**

P_1 with 50–100 segments of which only the terminal are longer than broad, and those only very slightly so; P_2 is similar to P_1, and usually of about the same length.

Brachials with smooth distal edges; ossicles of the division series with smooth borders and a smooth dorsal surface; no rudimentary terminal comb on the proximal pinnules (*Arctic Ocean, and southward to Norway and Nova Scotia; western shores of the Okhotsk and Japanese Seas from Cape Terpenia to Korea;* 12–1340 *meters*) ..... **Heliometra**

Brachials with spinous distal edges; ossicles of the division series with usually spinous borders and commonly with a greater or lesser development of spines on the dorsal surface; the proximal pinnules bear a rudimentary terminal comb suggesting that found in the species of the Comasteridae (*From Cape Horn northward along the western coast of South and North America to Alaska, thence westward and southward to southern Japan;* 11–1911 *meters*). **Florometra**

The genus *Heliometra* includes only the well known *Heliometra glacialis* (Leach) (= *Antedon eschrichti* [J. Müller] of P. H. Carpenter and earlier authors generally).

Anthometra, Solanometra, and *Florometra* are best considered as subgenera of *Promachocrinus.* A full account of the first two

and the last will be found in my memoir on Die Crinoiden der Antarktis.[3]

Subfamily ZENOMETRINAE A. H. Clark

Key to the Genera of the Subfamily Zenometrinae

P_1 and P_a absent (*Philippine Islands;* 140–148 *meters*) . . . . . **Balanometra**

P_1 and P_a present.

Cirri with all the segments elongated, the distal entirely without dorsal processes; or (very rarely) a few of the outermost cirrus segments may be but little longer than broad with slight dorsal tubercles.

Cirrus sockets arranged in closely crowded columns in each radial area; but the groups of columns in each radial area are usually (almost invariably) separated from the groups of columns in the adjacent radial areas by long triangular bare patches; the distal cirrus segments are always greatly elongated, never with any trace of dorsal processes (*From the Galápagos Islands and Panama northward to the Aleutian Islands, and southward on the Asiatic coast to Yezo Strait and the northern part of the Sea of Japan; the Hawaiian Islands; the Philippine Islands; the Lesser Sunda Islands; the Bay of Bengal and the coast of Travancore, and southward to the Antarctic regions;* 336–2858 *meters*) **Psathyrometra**

Columns of cirrus sockets somewhat irregular, and evenly spaced all around the centrodorsal without differentiation into radial groups; the distal cirrus segments may be much elongated with no trace of dorsal processes, or little, if any, longer than broad, with slight dorsal tubercles (*From the western coast of Scotland, and Ireland, southward to Madeira, including the entire Mediterranean basin;* 45–1292 *meters*) . . . . **Leptometra**

Cirri with the proximal segments more or less elongated, but the distal segments short, never longer than broad, and bearing prominent dorsal processes.

Division series and arm bases smooth; 10–14 arms (*Kei Islands and northern Cuba;* 252–380 *meters*) **Adelometra**

Division series and arm bases spiny.

Size large; cirri with more than 40 (50–60 segments; columns of cirrus sockets very regular, separated interradially by high ridges, or by broad bare areas. Two columns of cirrus sockets in each radial area,

[3] Deutsche Südpolar-Expedition, **16** (Zoologie, **8**), May 16, 1915, pp. 120–143.

the radial areas being separated by high ridges (*From St. Lucia, British West Indies, northward to Georgia and Pensacola, Florida;* 304–792 *meters*) ..... **Zenometra**

Three columns of cirrus sockets in each radial area, the radial areas being separated by broad bare areas (*Hawaiian Islands;* 346–633 *meters*). **Sarametra**

Size small; cirri with less than 30 segments; columns of cirrus sockets on the centrodorsal slightly irregular; interradial areas on the centrodorsal not especially differentiated (*Marion Island, and the shores of the Antarctic continent in the vicinity of Gaussberg;* 252–400 *meters*) ..... **Eumorphometra**

Subfamily ISOMETRINAE A. H. Clark

The only genus in this subfamily is *Isometra*, of which a complete account will be found in *Die Crinoiden der Antarktis*, pp. 145–146.[4]

Subfamily BATHYMETRINAE A. H. Clark

Key to the Genera of the Subfamily Bathymetrinae

All the cirrus segments short, the longest not so much as twice as long as the median diameter.

Cirrus segments cylindrical, without expanded distal ends, 25–33 (usually nearer the latter) in number, the longest (third-fifth) about one-third again as long as broad, those beyond the eighth about as long as broad, the distal slightly broader than long; IBr series and arm bases without lateral processes, and widely free laterally (*Western coast of Ireland;* 698 *meters*) ..... **Orthometra**

Cirrus segments with much swollen distal ends, not more than 20 in number; IBr series and brachials in close lateral contact (*Moluccas to Marion Island, southeast of Africa;* 1089–2880 *meters*) ..... **Tonrometra**

Proximal cirrus segments elongated, at least twice as long as the median diameter, and usually much longer.

Centrodorsal sharply conical with straight sides, nearly or quite as long as broad at the base (*Philippine Islands to Celebes;* 509–1901 *meters*) ..... **Fariometra**

Centrodorsal less sharply conical, with rounded sides, or hemispherical, and lower.

All the brachials have strongly produced and very spinous edges; P_1 very slender and delicate, markedly longer than P_2, with the outer segments very greatly elon-

[4] Deutsche Südpolar-Expedition, **16** (Zoologie, **8**), May 16, 1915.

gated with overlapping and spinous distal ends (*From southern Japan, the Hawaiian and Philippine Islands westward to Cape Comorin, thence southwestward to between Marion Island and the Crozets; from the Bay of Biscay northward to* 54° 17′ *N. lat., and from Brazil northward to the Newfoundland banks;* 248–2926 *meters*) **Trichometra**

The brachials do not have strongly produced and very spinous distal ends; at most the distal edges of the outer brachials are bordered with fine spines.

P_1 much elongated, between two and three times as long as P_2, composed of 30–40 segments of which a few of the basal are short, the following becoming slender and greatly elongated (*Arctic Ocean from western Greenland to the Kara Sea, and southward to Portugal and Chesapeake Bay, and also in the vicinity of Marion Island, southeast of South Africa;* 18–1800 *meters*) ..... **Hathrometra**

P_1 the same length as, longer than, or shorter than, P_2; but if longer never more than slightly so, and with not more than 20 segments.

Cirri with 20–30 relatively short segments of which the last six to thirteen are only very slightly, if at all, longer than broad.

Pinnules not especially long; distal pinnules the same length as the proximal pinnules; P_2 resembling P_3 and the following pinnules, slightly longer and stouter than P_3 with somewhat fewer segments which are proportionately longer; P_2 may bear a gonad, though these usually begin on P_3; arms 25 mm. to 60 mm. long; cirri L-LX, 21–30 (*Kei and Meangis Islands, and southern Celebes;* 204–1158 *meters*) **Nepiometra**

Pinnules very long; distal pinnules not so long as the proximal pinnules; P_2 very slightly shorter than P_1, but similar to it, with about 18 elongated segments; following pinnules similar; arms about 20 mm. long; cirri about XXX, 20–25 (*Southeastern South America;* 1080 *meters*) **Phrixometra**

Cirri with not more than 20 much elongated segments all of which are markedly longer than broad, especially the proximal.

More than XXV cirri, which have 10–20 segments (*Eastern Pacific, including the Seas*

of Okhotsk and Japan, from western Bering Sea to the Kermadec Islands and New Zealand, and westward to between Marion Island and the Crozets; southwest of Iceland; 144–3178 *meters*) . . **Thaumatometra**

Not more than XV cirri, which have not more than 10 segments (*Abysses of the Pacific from west of Tasmania to west of Japan;* 4680–5220 *meters*) . . . . . **Bathymetra**